

AMENDMENTS TO THE SPECIFICATION

A substitute specification is attached, in both marked-up and clean form. Kindly enter and utilize for examination purposes the substitute specification attached hereto as Attachment A.

Also attached, as Attachment B, is a copy of the substitute specification showing all the changes, including the matter being added to and the matter being deleted from the specification that forms part of the published international application upon which the present application is based (PCT/SE2004/001351), published as International Publication Number WO 2005/028307 A1).

The specification changes reflected in the attached substitute specification include the addition of the preferred subheadings at appropriate places within the specification, and they also include minor corrections, including corrections to improve the form of the application. None of the changes reflected in the substitute specification introduces new matter because each change is based upon the international application in the form in which it was filed, including the specification, abstract, drawings, and claims.

ATTACHMENT A**SUBSTITUTE SPECIFICATION**

(Including All Changes Made to the Specification in International Application No. PCT/SE2004/001351)

METHOD AND APPARATUS FOR CONNECTING A PASSENGER BRIDGE TO AN AIRCRAFT**BACKGROUND OF THE INVENTION****FIELD OF THE INVENTION**

[0001] The present invention relates to a method of connecting a passenger bridge to an aircraft, and to an arrangement for that end.

DESCRIPTION OF THE RELATED ART

[0002] Many airports now include passenger bridges which are connected to an aircraft from a terminal building and via which passengers embark and disembark. Several different types of passenger bridges are known to the art, of which one is a so-called Mobile Telescopic Bridge (MTB) that includes a number of telescoping parts, where the outermost part is supported by a bogie that has separately driven wheels. The bogie functions to maneuver the passenger bridge on the airport gate area apron toward and away from an aircraft. Located at the connection of the passenger bridge to a terminal building is a rotunda, which is rotatable about a vertical axis and which is supported by a ground-anchored pillar. Located in the outermost part of the passenger bridge is a cabin that can be rotated relative to the outermost telescopic element of the bridge. The cabin is that part of the arrangement intended for connection to the door of an aircraft.

[0003] A serious problem resides in the relatively long time taken for passengers to board the aircraft and also to disembark when the aircraft is parked at a so-called gate. This means that the time lapse from the time at which the aircraft has landed to the time at which it can re-start is unnecessarily long, which is both uneconomic and causes the passengers to feel that they are forced to wait unnecessarily.

[0004] It is undesirable for passengers to wait on the aircraft parking area for safety reasons.

[0005] Aircraft tend to be both larger and longer. A serious technical problem arises with regard to connecting a telescopic passenger bridge to a rear door that is located aft of a wing of an aircraft, due to the significant distance from the rotunda to a rear door. That distance can exceed 30-40 meters. There is found in that respect a solution in which the passenger bridge is suspended from a device that resembles a crane, so that the bridge is able to extend stably over the wing to an extent that enables the bridge to be connected to a rear door of the aircraft. That solution is both clumsy and expensive.

[0006] Another solution is described in Swedish patent specification 513 504. In accordance with that patent specification, the passenger bridge is given mobility through the medium of a drive means arranged in the outer part of the bridge and having wheels that rest against the airport parking apron surface, wherein the passenger bridge includes telescoping parts. In accordance with that patent specification, the passenger bridge is driven by the drive means after an aircraft has been parked, so as to cause the drive means and the outer part of the passenger

bridge to pass outwardly of the aircraft wing and then in behind the wing for connection to the rear door of the aircraft.

[0007] Although that Swedish patent provides a conceivable solution to the above-described problem, it itself causes a problem with regard to present-day large aircraft, such as the Airbus 380, which have two flight decks. In addition to requiring a passenger bridge in excess of 50 meters in length in order to move around the wing, the time taken to connect the bridge to a rear door would be unacceptably long. Moreover, the location of the bridge connection to the rotunda at the airport building would be much too high for the bridge to be connected to a rear door on the lower flight deck and to pass freely over the wing of the aircraft. The outermost tip of the wing of an Airbus 380 is situated at a greater height above the ground than are the doors on the upper deck.

[0008] The present invention solves that problem and provides a simple and convenient solution to the problem of connecting a passenger bridge to a rear door on the upper deck of a two-deck aircraft, and also a rear door on the lower deck of such an aircraft.

SUMMARY OF THE INVENTION

[0009] Accordingly, the present invention relates to a method of connecting the outer end of a passenger bridge to a door on the body of an aircraft, whereby the door is located on one side of the aircraft and aft of an aircraft wing. The inner part of the passenger bridge is connected to a terminal building via a rotunda, and the outer part of the passenger bridge carries a cabin intended for connection to the aircraft at a door

thereof. The passenger bridge is movable through the agency of a drive means that rests against a parking apron at the airport, through the medium of wheels included in the drive means. The passenger bridge includes telescoping parts. The drive means is located at the outer end of the inner part of the passenger bridge, thereby enabling the outer part of the passenger bridge to swing in a vertical plane relative to the inner part of the bridge. The passenger bridge is driven from a parking position to a docking position by means of the drive means after an aircraft has parked for connection to the passenger bridge. The drive means is positioned close to the leading edge of the aircraft wing while telescoping the inner part of the passenger bridge. The outer part of the passenger bridge is then swung down and the outer part telescopes outwardly to an end position at which the cabin can be docked with the aircraft body.

[0010] The present invention also relates to apparatus for carrying out the method.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will now be described in more detail partly with reference an embodiment of the invention illustrated in the accompanying drawings, in which

[0012] Fig. 1 is a side view of an Airbus A380 showing the several passenger door locations;

[0013] Fig. 2 shows the aircraft and passenger bridges from above;

[0014] Fig. 3 shows a passenger bridge connected to a rear door A4 on the lower deck of the aircraft;

- [0015] Figs. 4-6 illustrate the sequence of procedural steps of connecting the passenger bridge of Fig. 3 to the aircraft;
- [0016] Fig. 7 is a sectional view of the passenger bridge taken at the drive means and shows the placement of the bridge in relation to the aircraft;
- [0017] Fig. 8 shows three passenger bridges connected respectively to a rear door A4 on the lower deck and two front doors A2, A7 on the lower and the upper deck respectively;
- [0018] Fig. 9 shows a passenger bridge connected to a rear door A8 on the upper deck of the aircraft;
- [0019] Figs. 10-12 illustrate the sequence of procedural steps in connecting the passenger bridge of Fig. 9 to the aircraft;
- [0020] Fig. 13 is a top view showing three passenger bridges connected to a rear door A8 on the upper deck and to two forwardly located doors A1 and A2 on the lower deck, respectively;
- [0021] Fig. 14 is a side view of a passenger bridge connected to a forwardly located door on the upper deck;
- [0022] Fig. 15 is a side view of a passenger bridge connected to a forwardly located door on the lower deck; and
- [0023] Fig. 16 is a fragmentary side view of a connection region in which a part of the passenger bridge can be pivoted in a vertical plane.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Fig. 1 is a side view of an aircraft designated Airbus A 380, where the locations of the several passenger doors A1-A5, A7- A9 have been indicated.

[0025] Fig. 2 shows the aircraft 1 and passenger bridges 2, 3, 4 from above.

[0026] The present invention relates to a method of connecting the outer end 5 of a passenger bridge 4 to a passenger door A4, A5, A8, A9 on an aircraft body. The doors are located on one side of the aircraft and aft of the aircraft wing 6. The inner part 7 of the bridge is connected to a terminal building 8 via a rotunda 9. The outer part 10 of the bridge carries a cabin 11 which is intended for connection to a passenger door on the aircraft.

[0027] The passenger bridge 4 is movable through the agency of a drive means 12, which rests against the airport parking apron 15 on wheels 13, 14 (see Figs. 5 and 7). Bridge 4 includes telescoping parts 16, 17, 18, 19 as shown in Fig. 6.

[0028] In accordance with the invention, the drive means 12 is located at the outer end of the inner part 7 of the bridge 4. The outer part 10 of the passenger bridge can be swung in a vertical plane relative to the inner part 7 of the bridge.

[0029] When an aircraft has parked for connection to the passenger bridge 4, the bridge 4 is moved by the drive means 12 from a parking position, shown in Fig. 2, to a docking position, shown in Fig. 3, in which the drive means 12 is positioned close to the leading edge 20 of the aircraft wing 6 by telescopically extending the inner part 7 of the bridge. The outer part 10 of the bridge is then swung downwards relative to the inner part 7 of the bridge and telescopically extends to an end position in which the cabin 5 can be docked to the aircraft body, see Fig. 3.

[0030] The outer end of the passenger bridge is thus adapted for connection to a door on the body of the aircraft, the door being located on one side of the aircraft and aft of the aircraft wing 6. That outer end 10 includes the cabin 5, which can be swung about a vertical axis to take a position parallel with the aircraft body. The cabin 5 is also telescopically movable for limited movement to a position in which it lies adjacent to and around the door on the body of the aircraft.

[0031] The inner end 7 of the passenger bridge is connected to a terminal building 8. That connection is designed for connection of the inner end of the bridge to the terminal building via at least one rotunda 9 and a further passageway 21 for pedestrian traffic.

[0032] As mentioned previously, the passenger bridge 4 is movable through the agency of a drive means 12 provided on the outer part of the bridge. The drive means 12 is of a known kind and rests against the airport parking apron 15 on wheels 13, 14, wherein the wheels are preferably driven individually. The drive means enables the passenger bridge to be driven in any desired direction. The passenger bridge also includes, as known per se, telescopic parts, i.e., telescoping elements in the form of tunnel-like elements that are generally rectangular in cross section.

[0033] The telescopic construction of the passenger bridge and the design of the drive means described above are well known to the art and will not therefore be described in more detail.

[0034] The telescoping elements 16, 17 of the inner part 7 of the passenger bridge (see Figs. 4-6) are extended and withdrawn, respectively, as the passenger bridge is moved along the parking apron 15 by the drive means.

[0035] The telescoping elements 18, 19 of the outer part 10 of the passenger bridge are extended and withdrawn, respectively, with the aid of a suitably known drive means (not shown) that functions to extend and withdraw, respectively, the outer telescoping element 19 from and into the inner telescoping element 18.

[0036] In accordance with one preferred embodiment of the invention, the outer part 10 of the passenger bridge is hinged to the inner part 7 of the bridge, i.e., the elements 17 and 18 of the bridge are hinged together so as to enable the outermost part 10 of the bridge to be displaced in a vertical plane, relative to the inner part 7 of the bridge, as shown in Fig. 16.

[0037] The vertical position of the bridge outer part 10 is varied with the aid of force generating means acting between the outermost element 17 of the inner part 7 and the innermost element 18 of the outer part 10. Fig. 16 illustrates diagrammatically a pivot joint 22, such as a hinge, and a force generating means in the form of one or more hydraulic piston-cylinder devices 23 acting between the attachment points 26, 27 in the respective bridge elements 17, 18, respectively.

[0038] In accordance with a further preferred embodiment of the invention, shown in Figs. 4-6, the inner part 7 of the passenger bridge is hinged to the rotunda 9, so as to enable the inner part to be swung in a vertical plane. As shown in Fig. 7, the vertical position of the outermost end of inner part 7 of the bridge is varied with the aid of lifting means 24 adjacent the drive means 12. The lifting means 24 can have the form of a hydraulic piston-cylinder device.

[0039] Alternatively, the rotunda 9 can be raisable and lowerable so as to be able to take different vertical positions.

[0040] The rotunda is supported by a ground-mounted vertical pillar 25. When the rotunda can be raised and lowered, the rotunda 9 is supported by a ground-mounted vertical pillar that includes lifting means, such as a hydraulic piston-cylinder device, for changing the length of the pillar and therewith displacing the rotunda in a vertical direction.

[0041] However, it is preferred that the inner part 7 of the passenger bridge is hinged to the rotunda 9 so as to enable the inner part to be swung in a vertical plane, and that the vertical position of the inner bridge part can be varied with the aid of the lifting means 24 at the drive means 12.

[0042] In accordance with a highly significant embodiment of the invention, the inner part 7 of the bridge and its outer part 10 are movable into a vertical position in which the bridge 4 will pass freely over the upper surface of the wing 6. Vertical movements of inner part 7 can be made prior to moving the bridge 4 in over the wing 6 of the aircraft and also subsequent to having moved the bridge 4 in over the wing.

[0043] Those movements are shown in Figs. 4-6, of which Fig. 4 illustrates a starting position where the aircraft is parked; see also Fig. 2. The reference numeral 28 marks the outmost tip of the wing 6. Fig. 5 illustrates the position where the drive means 12 has been driven to a position close to the leading edge 20 of the wing 6 during outward telescoping of the inner part 7 of the bridge. Fig. 6 shows the outer part 10 of the bridge being telescoped outwardly and then lowered into docking position with a rear door A4 on the lower deck, as shown in Fig. 3.

[0044] Fig. 8 illustrates from above the state in which the passenger bridges of Fig. 2 have been docked to both forwardly located doors A2 and A7, and a rearwardly located door A4 on the lower deck.

[0045] The passenger bridges 2 and 3 are conventional telescoping bridges. Those bridges can also be swung in a vertical plane with the aid of lifting means at respective drive means 12 to allow connection of the bridges with forwardly located doors at different heights above ground level.

[0046] Figs. 10-12 illustrate a sequence corresponding to that illustrated in Figs. 4-6, although in this case the passenger bridge 4 is shown docked to a rearwardly located door A8 on the upper deck of the aircraft.

[0047] Fig. 13 illustrates from above the state in which the bridges shown in the figure have been docked both to forwardly located passenger doors and to a rearwardly located passenger door A8 on the upper deck.

[0048] Fig. 14 is a side view of the forwardly located passenger bridge 2 docked to a forwardly located door A7 on the upper deck.

[0049] Fig. 15 is a side view of the forwardly located bridge 2 docked to a forwardly located door A2 on the lower deck.

[0050] The passenger bridge 4 can be docked to rearwardly located doors on both the upper and lower deck, by virtue of the fact that the bridge 4 can be raised to an extent such as to allow the drive means 12 to reach the region of the leading edge of the wing of the aircraft, in combination with the ability to swing down the outer part 10 of the bridge 4 relative to the inner part 7 of the bridge. Docking is achieved relatively quickly, since the passenger bridge is moved to a limited extent on the

ground, from its starting position to its end position at the leading edge of the wing. In addition, two other passenger bridges are docked to two other forwardly located passenger doors at the same time.

[0051] It is obvious that the present invention solves the problems identified in the introduction.

[0052] Although the invention has been described with reference to a number of exemplifying embodiments thereof, it will be obvious that those embodiments can be varied. For example, the passenger bridge drive means can include more than one wheel pair and more than one support means. Furthermore, the bridge 4 pivoting means at the junction of the inner and outer parts can have some other design. In addition, the outer part 10 of the passenger bridge can be provided with a downwardly swingable vertical support at its outer end, such as an hydraulically operated support.

[0053] The present invention shall not therefore be considered limited to the above-described and illustrated exemplary embodiments thereof, since variations and modifications can be made within the scope of the following claims.